

VIELE (E.L.)

REPORT
ON
CIVIC CLEANLINESS,
AND THE
ECONOMICAL DISPOSITION
OF THE
REFUSE OF CITIES.

BY

EGBERT L. VIELE,

CHAIRMAN OF THE COMMITTEE.

Committee:

EGBERT L. VIELE, NEW YORK,	E. M. SNOW, M. D., RHODE ISLAND,
CHAS. H. HASWELL, "	OTIS CLAPP, BOSTON,
HENRY GUERNSEY, M.D., "	HENRY IRWIN, VIRGINIA.

NEW YORK :
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1860.



Resolution, adopted at the third National Quarantine and Sanitary Convention, held in the city of New York, April 27th, 1859 :

* *Resolved*, "That a committee of six members be appointed, on Civic Cleanliness, with plans for the disposition of Offal, Refuse, Street-cleanings, and Nightsoil of cities."

* * * * *

Committee on Civic Cleanliness and the Economical Disposition of the Refuse of Cities.

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THE Committee on Civic Cleanliness and the Economical Disposition of the Refuse of Cities, appointed at the third session of the National Quarantine and Sanitary Convention, held in the City of New York, April 27th 1859, beg leave to submit the following

R E P O R T :

The very comprehensive nature of the subject referred to the Committee would seem to open so wide a field of inquiry into all matters connected with the hygiene of cities, as to embarrass them in selecting the precise line of facts which they should present for consideration. Civic Cleanliness forms not only the ground-work but the superstructure of Sanitary Reform, comprehending as it does the removal of everything that is impure; and, therefore, to do entire justice to the subject, the report should embrace nearly every question in sanitary science. In view, however, of the valuable reports submitted at the third session of the Convention (especially the report of Dr. John Bell on the importance of sanitary measures to cities), exhibiting so much research, and containing such

an amount of information, drawn from the history and experiences of the past, the Committee feel that this report may, with propriety, be confined to a few practical suggestions with regard to the sources and the removal of those impurities which are manifestly the chief causes of mortality.

If there were a city whose natural position was perfectly salubrious, and whose artificial constructions were all completed and based upon the principles of sanitary science, that city might be said to be in a normal hygienic condition that is, in a condition where the exercise of a proper degree of civic cleanliness would insure the health of the inhabitants. In order, therefore, to accomplish the full measure of sanitary reform in cities, it is necessary to bring them to this normal condition. To accomplish this, there are four leading subjects which demand attention in the order they are named, viz. :

1. *Drainage.*
2. *Paving.*
3. *Supply of Water.*
4. *Sewerage.*

When the municipality shall have completed these four necessary measures, and not till then, the responsibility for the health of the city rests upon the individual inhabitants; and a compliance, on their part, with proper sanitary regulations, will undoubtedly secure an exemption from all preventable diseases.

The importance, however—the vital necessity—of carefully and thoroughly accomplishing the above-named four elements of a normal hygienic condition, cannot be exaggerated. Let us refer to them in detail.

I.—DRAINAGE.

Of the total number of deaths which take place annually, over the whole surface of the globe, nearly one-half are caused by fever in its different forms. To this may be added the number who perish by diseases which originate under circumstances similar to those which produce fever.

It is a well-established fact, that the principal cause of fever is a humid miasmatic state of the atmosphere, produced by the presence of an excess of moisture in the ground, from which poisonous exhalations constantly arise, vitiating the purer air, and carrying into the system of those who inhale it a virus which, if not sufficiently intense to produce fever, has such a disturbing effect upon the functions of some organ, or set of organs, as to weaken the general system, and act as a powerful predisposing cause of some of the most common and fatal maladies to which the human body is subject. It follows, as a matter of course, that the first efforts to improve the salubrity of any place whatever, must be directed towards preventing the aggregation of water in particular localities, and to remove such as has been allowed to collect.

In order to illustrate more clearly this subject of drainage, let us examine it in connection with a district of country where the surface is in a perfectly natural condition, unaltered or unaffected by any artificial improvements, diversified by hills and valleys, the elevations and depressions forming the water-sheds and water-courses by which the ground is partially relieved of the excess of rain which falls upon it.

The evaporation, which is constantly going on under the influence of solar heat upon the waters of the

ocean and of the land, carries into the atmosphere large quantities of moisture, which, through changes of temperature, becomes condensed, and descends again upon the earth. But a small portion of that which is annually discharged from the clouds is necessary to vegetation or is absorbed by the ground. A portion of it passes off on the surface into the rivulets and rivers, and thence into the ocean. Another portion descends through the soil by the force of gravity, until it meets with an impermeable substratum, flowing along which it either accumulates in hollow basins, or diffuses itself through extensive tracts of subsoil, finding vent in the shape of springs; or by spreading itself over a large mass of soil, it saturates it as a sponge, rendering it unfit for cultivation, creating marshes and swamps, whence arise the malaria so destructive to health.

These are visible effects; but there is another condition by means of which this surplus water is rendered injurious to vegetation and to health. As soon as a portion of water is beneath the surface, it is acted upon by capillary attraction in addition to the force of gravity, the tendency of which is to hold it in suspension, whereby the soil becomes soured and chilled by the evaporation, which carries the water off in the shape of mist, so that, in those sections of country where there is no evidence of marshes or swamps, the nature of the soil may be such as to render it extremely unhealthy. In fact, there are but few soils which do not require draining, both for agriculture and for health. If, therefore, such is the natural condition of soils, how much greater does the evil become magnified, when in the progress of civic improvements, we disregard altogether the natural outlets by which the soil became relieved of its surplus water, and by obstructing the drainage, add to the difficulty already existing.

The lines and direction of the streets, are generally determined by other than topographical necessities, and consequently, it becomes necessary to remove the inequalities of the surface by leveling the elevations and filling the depressions, under the supposition that when the grading is completed, the artificial surface-channels will convey all of the water away ; but such is not the case. The very material thrown into the hollows, forms a nucleus for increasing the amount, and not only a larger quantity of moisture will be retained, but it will have added to it the drainings through the animal and vegetable refuse which accumulates in all large cities. Each year adds to the evil, until some dreadful epidemic shows itself in these very spots, and startles the community into a knowledge of their danger ; the sense of fear, alone, accomplishing what their intelligence should have taught them, and they set about, perhaps too late, providing a remedy for their own recklessness. The older cities of Europe have had their bitter experience in this very matter. In the city of Glasgow, for the five years ending 1840, 55,949 persons were attacked with fever—every fifth person in the city. Of these, 4,788 died. The city of London has probably suffered more from imperfect drainage than any other city in the world ; and even at this day, after years of labor, and an enormous expenditure of money, that city is still suffering through the ignorance and errors of the past, from evils which may never be wholly eradicated.

Hamburg, Berlin, and Vienna all testify to the same thing ; and as most conclusive testimony, we have the statement that the fearful scourges, which have from time to time swept over Europe, have, on each return, broken out in

precisely the same localities in every city, where the un drained soil was ready to generate the elements required to bring them into activity. The cities of the United States, having been generally located with reference to commercial necessities, are, in many instances, worse off than those of Europe ; in addition to this, their growth is so much more rapid that a very few years finds them covering an extensive area of ground which has never been prepared for the purpose ; the consequence is that drainage becomes impossible. Undrained lots are covered with houses, the residents in which are unaccountably sick more or less all the time, and when an epidemic comes the death-rate is frightful. If what has been stated is true, it follows that a neglect of proper drainage in cities is little less than criminal. It cannot be accomplished by individuals, since it must be done according to a complete and extensive system embracing the whole municipality.

The responsibility rests, therefore, with the constituted authorities, and to them the people should appeal in every city. Let the subject be considered in each locality for itself, and a report of facts be made as they exist. The remedial measures must follow. The courses of all original drainage streams should be religiously preserved by first excavating them to a firm subsoil, and then constructing in their beds dry stone drains, covered with flat stones, through the interstices of which the water could percolate. The same kind of drains should be opened into all depressions which have no natural outlet, and in which water originally accumulated. These steps should precede the grading of streets, or, if that has been done, the drains should be conveyed under them.

II.—PAVING.

There is perhaps no one subject connected with the growth and improvement of cities which has had so marked an effect upon the health of the inhabitants as that of paving the streets. Although next in importance to the removal of surplus water from the soil, as a general rule it is not thought of, unless the nature of the soil, or the constant traffic compels a resort to it in order to facilitate business. It has seldom been resorted to simply as a sanitary measure, yet the history of a large number of cities shows conclusively that a great decrease in mortality is due alone to the paving of certain streets in localities previously noted for their unhealthiness. This is owing to the fact that less water gets into the soil, and the latter being covered by the pavement, is not acted upon by the direct rays of the sun, thus preventing the generation of deleterious gases and miasma. Dr. Bell cites the city of Philadelphia as an instance of the great benefits derived from pavements, and states that the exemption of the inhabitants from intermittent and bilious remittent fever has, with great uniformity, followed the paving of the streets.

The space now called Dock street was, in the early history of Philadelphia, a miry swamp traversed by a sluggish stream, on either side of which periodical fevers of all grades prevailed with a violence equal to those met with in the most sickly districts of the West. The exposed surface having been paved and the creek partly filled and covered over, and made the line of a large drain, no person residing there now has any apprehension of fevers such as those that affected the former dwellers there. A like change from the operation of a similar cause has been wrought in the

districts of Southwark, Kensington and Richmond. The change in the sanitary condition of Southwark is the more obviously due to paving, and subsequent attention to scavenging, as the greater part of the drainage is on the surface, owing to the limited extent of sewers.

Louisville, Kentucky, is mentioned by the same writer as furnishing one of the most remarkable examples of the beneficial change produced in the health of a city by paving. This city—once called “the grave-yard of the west”—is now as healthy as any town in that extensive region. Intermittent fever was a regular annual visitor, and occasionally a form of bilious fever prevailed, rivaling yellow fever in malignity, and threatening to depopulate the town. After the fever of 1822, the citizens seem to have become awakened to a sense of their condition, and as a means of avoiding the evils from which they suffered, a system of improvements was introduced, the principal feature of which was the paving of the streets. An entire change in the sanitary condition of the city followed immediately.

It seems unnecessary to multiply instances—the facts are the same everywhere. No city can be healthy unless the streets are paved, and they should be well paved in the beginning. An inferior pavement is almost worse than none at all, as it is constantly out of repair, and fails in its purpose as a sanitary measure ; and when we take into consideration all the inconvenience and evils attendant upon a bad pavement—the frequent repairs required, the additional wear of carriages, the greater amount of traction, and consequent loss of power, and the injury to horses—it will be found that a cheap pavement is always the most expensive in the end. Besides the cleanliness of a city—

its scavenging, depends so much upon its pavements, for whatever may be the character of the soil, it is impossible to keep the streets cleaned unless they are well paved. The refuse matter which collects upon the surface, and which it is impossible to remove except from a pavement, becomes incorporated with the soil, and supplies a constant and fruitful source of disease ; and in a *bad* pavement, the holes that are constantly being formed are the receptacles for offensive materials. Even a hard rain, instead of contributing to cleanliness, has a contrary effect, by fermenting those substances which, in a dry state, would in some measure continue inactive, and in a great degree harmless.

Assuming it, therefore, to be admitted that the pavement of the streets is a matter of the first necessity, an important question arises at once as to the character of the pavement : What materials are the best ? and how it should be constructed ?

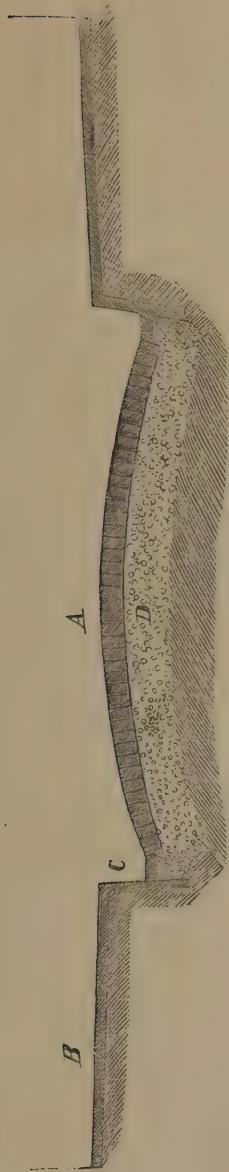
Unfortunately, the question of economy must be discussed at the same time, if we expect any satisfactory result (and this report aims to be practical) to arise out of the discussion.

The conditions of a perfect pavement are, a light grade, easy traction, and a good footing for horses. It should be so constructed that water could not percolate through or under it, so that it would not be liable to get out of repair, and so that any portion could be readily taken up and replaced without impairing its stability.

The only pavement fulfilling all these conditions, combined with durability in the material, is the concrete pavement, or small cubical blocks of primitive rock laid upon a bed of concrete. Innumerable experiments and ingenious

inventions have been tried, in almost every city of the world, to determine upon a pavement fulfilling all the necessary conditions, but nothing has been found to excel or to equal the old Roman pavements, which have survived the lapse of time and destruction of every thing cotemporary with them, and bid fair to survive the very memory of those who constructed them.

The principles on which the Roman pavements were constructed are those which are requisite to a good pavement. There can be no question as to this character of pavement being the only one which will stand our climate. Whenever a pavement is so constructed as to admit of water percolating through into the road-bed, there the frost will follow, and the pavement will be upheaved. Cobble-stone pavement is a mere temporary expedient. Where there is any amount of travel it is always out of repair, while the cubical block pavement now being extensively used in New York will be worse than cobblestones in a few years, with nothing but sand underneath, which will be wet and frozen in the winter, and of course thrown up, when the angular blocks will be very destructive to carriages. As the expense of concrete underneath is but a small addition to the original cost, while the expense of repairs will be one hundred per cent. less, it is to be regretted that the latter pavement is not universally adopted at first, as it certainly will be in the end. I have no hesitation in recommending that every city should at once lay down a specimen of this pavement, to be examined, and tested, and compared with every other kind, as to durability, cost, and value. The citizens will soon learn to appreciate its merits, and its general adoption must follow, to the great improvement of the comfort and health of the inhabitants.



Face p. 14.

III.—SUPPLY OF WATER.

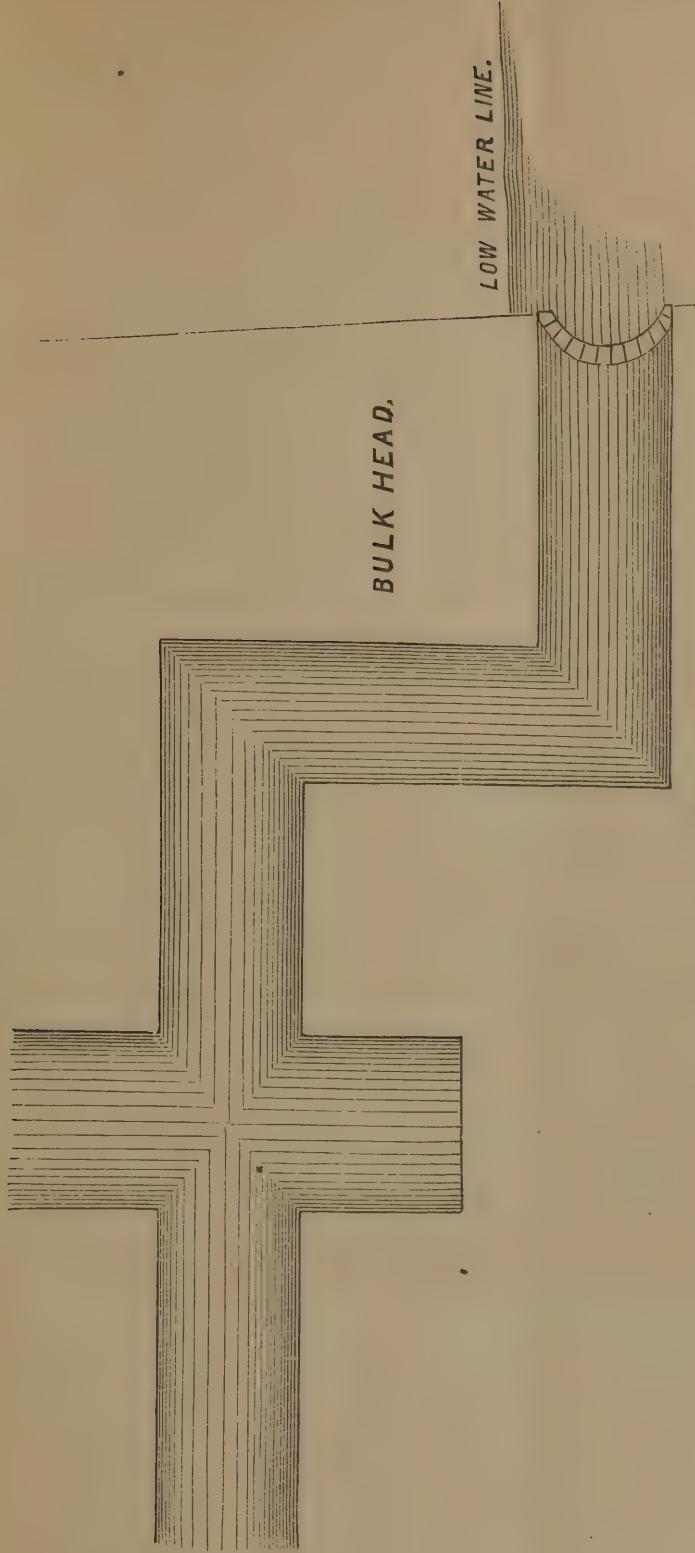
In a military point of view, next to a city's defense is an abundant supply of good water, and the fact holds good in every point of view—without it no city can be clean or healthy, to say nothing whatever of comfort. Water alone can remove the thousand impurities which are inseparably connected with a large population, and where it is connected, as it should be, with a properly constructed system of sewers, a great step is taken towards securing the health of the city.

The aqueducts and sewers of ancient Rome, which, even in their ruins, excite our wonder and admiration—through which whole rivers were turned into that city—enabled her to preserve the laws of health, and so to gather within her walls, without fear of pestilence, an immense population. But, when those laws were neglected by the lawless democracy into whose hands the control of the city fell, her downfall and desolation began. To her sanitary regulations she owed her imperial splendor; to their neglect she owed her ruin. No better illustration than that of Rome can be furnished of the value to a city of a copious supply of water. It attracts population, and increases the value of property to an extent which soon repays the outlay for the construction of the works. In fact, if the works are of the right character, built with a view to the increase of population, and such as to insure an ample supply of water, they cannot fail to be a source of revenue to a city.

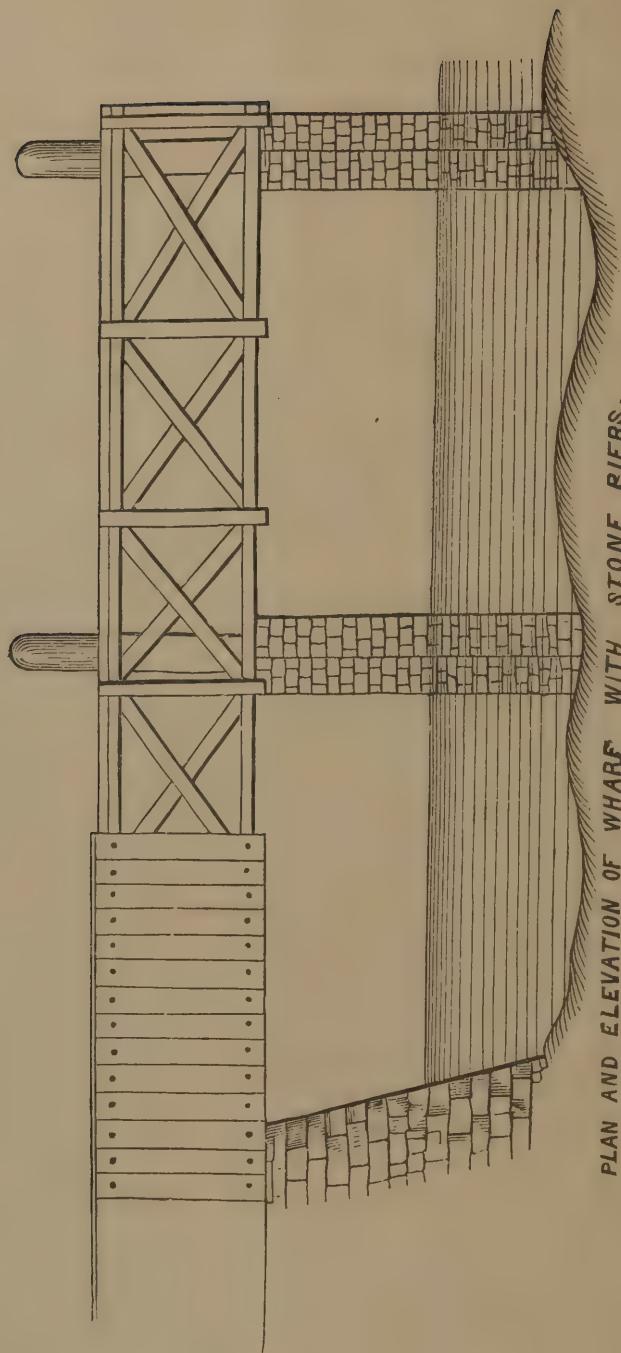
IV.—SEWERAGE.

A supply of water necessitates the construction of sewers. In fact, it is a doubtful experiment to attempt to

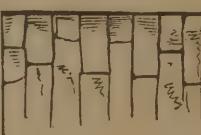
use them without the necessary amount of water to insure their being kept clean, for they may become the source of the most frightful disorders. This problem of sewerage is by no means an easy one to solve in communities where progress is the result of individual prosperity. It is a difficult matter to persuade people to look forward to the comfort of generations to come after them, when they have to furnish the means for it. And nothing is so essential to the success of a system of sewerage, as to make it sufficiently extensive and comprehensive in the beginning. The main trunk sewers, which may be more than sufficient for the necessities of one generation, are found to be too small for the branches which are gradually emptied into them, and, as a consequence, being unable to carry off the sewage, they become choked up, and produce discomfort and disease, where they were intended to secure comfort and health. While it is not necessary to lay down here a plan for the construction of sewers, yet it is not out of place to call attention to the necessity of keeping the mouths of the sewers below the surface of the water in which they are conveyed. This can be readily done by depressing the sewer suddenly at the stream, creating a fall near the river, so that that portion of the sewer which is between the fall and the river will be always filled with water. This is necessary, in order to prevent the rush of air through the sewer from the river, which drives the sewer gases into the houses, and fills the atmosphere itself with foul odors. Another cause of the ascending of sewer-gases is the practice which ought not to be tolerated of admitting pipes into the sewers for the discharge of waste steam. Nor should the washings from gas-works or manufactories be allowed, under any circumstances, to go into the public sewer.



Face p. 16.



PLAN AND ELEVATION OF WHARF WITH STONE PIERS.



Docks.

Although not precisely in the hygienic connection which has been laid down in the beginning of this report, yet the docks, wharves, piers, and bulk-heads of a city are often such positive causes of insalubrity, that it is proper to refer to them here. While there is no period in the history of the city when every other question should not be regarded as secondary to its sanitary condition, yet it becomes necessary to tolerate the existence for a time of certain evils which should be removed the moment the public health demands it, and under this head are the temporary wharves and piers for the use of shipping. The manner of constructing them is by sinking cribs made of logs, and filled with stones, or by driving piles into the bed of the stream, and then erecting constructions upon them. These piles decay above the water-line, and are replaced by driving new ones along side of the old. No arrangement could be devised which would be better calculated to check the tidal currents, to collect the refuse which is thrown into the river, and to aid sedimental deposits, all of which tend to make the vicinity of the wharves, and even the river itself, a source of pestilence.

It is hardly necessary to say that these constructions ought to be replaced by more durable structures, better adapted to the necessities of a city and the wants of commerce. In the first place, they should be built of stone, or at least upon stone piers. The superstructure may be of wood. The accompanying diagram exhibits a plan and elevation of a wharf built on stone piers. Certainly, no city, which owes its existence and prosperity to commerce, ought to hesitate in providing that commerce with all necessary and decent facilities. As it is now, with hardly a solitary exception,

the wharves and piers of our cities are regarded as the most offensive, most dilapidated, and most unhealthy part of the town.

The slips are filled with mud, requiring constant dredging. The vilest refuse matter, dead animals of every description, are floating backwards and forwards with the ebbing and flowing tide. Vice and filth seem to revel unchecked in their precincts; ragged, thieving boys and debauched men, rubbish and old lumber, ricketty shanties, grog shops, and all manner of low dens, meet the eye in every direction. Such is a picture of the wharves of a commercial city in the United States, whereas they should be solid ornaments to the city, spacious in their proportions, with ample room for shipping. The severest penalty should attend the throwing of any refuse into the water. Garbage-carts should attend upon the shipping in dock as they do upon the dwellings. They should be kept clean by thorough and frequent washing. A well-organized and active police should prevent the violation of ordinances, and arrest the vagrants. I am free to say that such a state of things would tend to elevate the character of the sailor. The docks and their vicinity are his home on land, and he cannot but feel and be degraded under the influences which surround him. Surely there is money wasted somewhere in our municipal governments, which might be expended in improving the condition of their wharves. If they are private property, let the owners be compelled to erect suitable constructions, and let them follow the laws of property everywhere, by exacting suitable compensation for their use. I cannot close this branch of the subject, without expressing the hope that some effort will be made to draw public attention to the disgraceful neglect of the accommodations for shipping.

PUBLIC MARKETS.

It is not out of place to refer also to the subject of markets, which too frequently, in large cities, are a disgrace and a nuisance. At this day there is not a decent public market-house in the city of New York. It is surely a great error to allow these places, which ought to be, with their fruits and flowers and fresh vegetables, an attractive place to visit, to become revolting depots of filth, where moral pollution keeps pace with the accumulation of mud and putridity. Millions of dollars are expended on jails and penitentiaries, while the hot-beds of vice, from which they are filled, are wholly unattended to.

Contrast the different effect which must be produced upon the minds of those whose occupation is to supply the daily quota of food to the city, if their business were conducted in large, airy, and commodious buildings, instead of men, women, and children being huddled together in ricketty shanties encumbered with refuse, where every sense is offended, and what should be a pleasure becomes a disgust.

Until suitable buildings are provided, no sanitary regulations can improve their condition. When these shall be erected, a careful examination of every thing that is offered for sale, a constant use of water, and the immediate removal of the refuse which will otherwise accumulate during the day and become a source of disease, will obviate the evils which exist. The buildings themselves would be an ornament to the city ; they would be the resort of strangers as well as residents, and a clean and orderly set of men and women would replace the noisy assemblage which is now to be found in them.

THE ECONOMICAL DISPOSITION
OF THE
REFUSE MATTER OF CITIES.

The various questions which arise under this head—such as the best mode of removing the refuse matter—when it should be done—the actual or relative value of the different kinds of refuse—their adaptation to agriculture, or to other uses—increase in importance with the increase of population. In a very dense population, like Paris, persons are found who turn everything to account, and such is the strife among what are known as *chiffoniers*, that they are licensed and assigned to districts. Scarcely a particle of refuse matter is wasted. Also, in some of the other larger cities of Europe, the cleaning of the streets, instead of being a tax, yields a revenue. In order to exhibit this matter in an economical point of view, it has been deemed proper to insert here the admirable essay upon this subject by Baron Liebig, contained in a communication to Alderman Mecchi, of London. Although the matter is not treated by the Professor in a sanitary sense, yet the entire paper is too valuable, taken in this connection, not to meet with due attention.

"MUNICH, Nov. 17.

"DEAR SIR:—Your letter, of the 7th of November to *The Times*, furnishes me an occasion to express to you my sincere thanks for the views to which you there give utterance, and which I have labored many years to impress. I am sorry not to be able to say that my efforts have been

attended with any perceptible results, and I regard it as a fortunate event that a man of so eminently practical a character as yourself has now, for the first time, in the interests of agriculture, and the national welfare, taken up the question of the ‘sewerage of towns’ with warmth, and in language adapted to produce conviction.

“It is my ardent wish that you may succeed in awakening the English people to your own convictions; for, in that case, the ways and means for setting aside the difficulties which stand in the way of procuring manure from the ‘sewerage of towns’ will certainly be found, and a future generation will look upon those men who have devoted their energies to the attainment of this end as the greatest benefactors of their country.

“The ground of my small success lies clearly in the fact, that the majority of farmers do not know the extent to which their own interests are concerned in this matter, and because the views and conceptions of most men, in regard to the circuit of life and the laws which govern the preservation of the race, do not generally rise above those of C. Fourrier, the inventor of the phalanstery. He proposed, as you know, to supply the wants of the occupants of his phalanstery by means of eggs. He supposed it was only necessary to procure a couple of hundred thousand hens, each of which would lay thirty-six eggs a year, making as many million eggs, which, sold in England, would produce an immense income. Fourrier knew very well that hens lay eggs, but he seemed not to know that, in order to lay an egg, they must eat an amount of corn its equal in weight; and so most men do not know that the fields, in order to yield their harvests, must either contain, or else receive from the hands of man, certain conditions which stand in

the same relation to the products of the field as the hen's food does to the eggs she lays. They think that diligent tillage and good weather are sufficient to produce a good harvest ; they, therefore, regard this question as one in which they are wholly unconcerned, and look forward carelessly and with indifference to the future.

" As physicians who, in the apparent signs of a young man's blooming health, discern the fatal worm which threatens to undermine his organic frame, so in this case should these discerning men, who are capable of comprehending the range of the question, raise the earlier the voice of warning.

" It is true that the diligent tillage of the fields, sunshine, and timely rain are the outward conditions, perceptible to all men, of good harvests ; but these are perfectly without effect upon the productiveness of the field, unless certain things, not so easy of perception by the senses are present in the soil, and these are the elements which serve for nourishment, for the production of roots, leaves, and seeds, and which are present in the soil always in very small quantity, in proportion to the mass of the soil itself.

" These elements are taken from the soil in the products of the field—in the corn or in the flesh of the animals nourished by these products ; and daily experience shows that even the most fruitful field ceases, after a certain series of harvests, to produce these crops.

" A child can comprehend that under these circumstances a very productive field, in order to remain very productive, or even simply productive, must have the elements which had been withdrawn in the harvests perfectly restored ; that the aggregate of the conditions must remain in order to

produce the aggregate results, and that a well, however deep it may be, which receives no supply of water, must, in the end, become empty, if its water is constantly pumped out.

"Our fields are like this well of water. For centuries those elements which are indispensable to the reproduction of the crops have been taken from the soil in those crops, and that, too, without being restored. It has only recently been ascertained how small a supply of these elements the soil really has. A beginning has been made to restore to the fields the losses which they sustain through the annual harvests, by introducing, from external sources, manures containing the same elements. Only a very few of the better informed farmers perceive the necessity of this restoration, and those of them who have the means have zealously endeavored to increase the amount of these elements in their fields; but by far the greater part of them know nothing of such restoration. They think that they may continue to take from the field as long as there is anything left, and that it will be time enough to provide for this necessity when it knocks at their doors. They do not, of course, know how large their stock on hand is, nor are they aware that when the necessity shows itself there will be no means to correct it; they know not that what they have wasted is irretrievable.

"The loss of these elements is brought about by the 'sewerage system of towns.' Of all the elements of the field, which, in their products, in the shape of corn and meat, are carried into the cities, and there consumed, nothing, or as good as nothing, returns to the fields. It is clear that if these elements were collected without loss, and every year restored to the fields, these would then re-

tain the power to furnish every year, to the cities, the same quantity of corn and meat ; and it is equally clear that if the fields do not receive back these elements, agriculture must gradually cease. In regard to the utility of the avails of the ‘sewerage of towns’ as manures, no farmer, and scarcely an intelligent man, has any doubt, but as to their necessity, opinions are very various.

“ Many are of the opinion, that corn, meat, and manure are wares, which, like other wares, can be purchased in the market ; that with the demand the price may, perhaps, rise, but this will also stimulate the production, and that all turns upon having the means to purchase, and so long as England has coal and iron she can exchange the products of her industry for the corn, meat, and manure which she has not. In this respect I think it would be wise not to be too confident of the future, for the time may, perhaps, come, even in half a century, that not one of those countries upon whose excess England has hitherto drawn will be able to supply her with corn, and that, too, from the natural law, that what is true of the smallest piece of ground is true also of a great country. It ceases to produce corn if the conditions of the reproduction of the corn which has been carried off are not restored to it. Nor is it, furthermore, certain whether the corn-growing countries will always desire to exchange their corn for the products of English industry, since they may no longer need these products, or, at least, not in the ratio of England’s need of corn. In the countries of Europe, and in the United States of North America, great efforts are made to become in this respect independent of England, as being in the end the only way of keeping the corn prices in these countries so as to repay the labor.

"In the United States the population increases at a still greater ratio than in other countries, while the corn production upon the land under cultivation has constantly fallen off.

"History teaches that not one of all those countries which have produced corn for other lands have remained cornmarkets, and England has contributed her full share towards rendering unproductive the best lands of the United States, which have supplied her with corn precisely as old Rome robbed Sardinia, Sicily, and the rich lands of the African coast, of their fertility.

"Finally, it is impossible in civilized countries to raise the corn production beyond a certain limit, and this limit has become so narrow that our fields are no longer capable of a higher yield without an increase of their effective elements by the introduction of manures from abroad.

"By the application of guano and bones the farmer of most limited capacity learns the real import of such increase; he learns that the pure system of stall or home-made manures is the true and genuine robber system. In consequence of his restoring in the guano and bones but a very small portion of those very same elements of seeds and of fodder which had been withdrawn from his fields by centuries of cultivation, their products are wonderfully increased. Experiments instituted with special reference to this end in six different parts of the kingdom of Saxony showed that each hundred weight of guano put upon a field produced 150 lbs. of wheat, 400 lbs. of potatoes, and 280 lbs. of clover more than the same sized piece of ground without guano, and from this it may be calculated how enormously the corn and flesh production of Europe

has been increased by the yearly importation of 100,000 tons, or 2,000,000 cwt. of guano.

"The effect of guano and bones should have taught the farmer the real cause of the exhaustion of his fields; it should have taught him in what a condition of perpetual fertility he might have preserved his fields if the elements of the guano, which he has transported in the shape of meat and products of his field into the cities, were recovered and brought into a form which would admit of their being restored to his fields every year.

"To an understanding of this, however, the farmer has not yet come, for, as his forefathers believed that the soil of their fields was inexhaustible, so the farmer of the present day believes that the introduction of manures from abroad will have no end. It is much simpler, he thinks, to buy guano and bones than to collect their elements from the sewers of towns, and, if a lack of the former should ever arise, it will then be time enough to think of a resort to the latter. But of all the erroneous opinions of the farmers this is the most dangerous and fatal.

"If it is perceived that no country can perpetually supply another with corn, then must it be still easier to understand that an importation of manures from another country must cease still earlier, since their exportation diminishes the production of corn and meat in that country in so rapid proportions that this decrease in a very short time forbids the exportation of manures. If it is considered that a pound of bones contains in its phosphoric acid a necessary condition for the production of sixty pounds of wheat, that the English fields have become capable by the importation of one thousand tons of bones of producing two hundred

thousand bushels more of wheat in a series of years than they would have produced without this supply, then we can judge of the immense loss of fertility which the German fields have sustained by the exportation of so many hundred thousand tons of bones which have gone from Germany to England. It will be conceived that if this exportation had continued, Germany would have been brought to that point that she would no longer have been able to supply the demand of her own population for corn. In many parts of Germany, from which formerly large quantities of bones were exported, it has now already come to be the case that those bones must be at a much higher price bought back again in the form of guano in order to obtain the paying crops of former times.

“The exportation of bones for so many years from Germany was possible only because the German agriculturists had less knowledge of the real nature of their business than the English, believing, as they did, that practice and science taught doctrines contradictory to each other, and were fundamentally different things, and that they must trust, not in the laws of nature, but in receipts. Things have now changed for the better, although not to the extent which was to be desired, for the German farmers do not as yet generally understand the value of the elements of bones for preserving the present fertility of their fields (not to speak of the restoration of their former fertility), for if they all understood this, no one could have any more bones—at all events, no more than those which he brings to market in his grain and cattle.

“The prices of bones have become so high in Germany as to forbid their exportation, and if the question should be put to English commerce, whence it furnishes the English

farmer, with this, to him, so indispensable a manure, the answer would produce astonishment; for this commerce has already so far robbed all the inhabited parts of the earth that the manufacturer of superphosphate can only set his hopes upon the phosphate of lime of the mineral kingdom.

" In relation to guano I have been assured that in twenty to twenty-five years, if the use of guano should increase in even the same proportion as hitherto, there will not remain in South America enough to freight a ship. We will, however, suppose its supply and that of bones to continue for fifty years, or even longer; then what will be the condition of England when the supply of guano and bones is exhausted?

" This is one of the easiest of all questions to answer. If the common 'sewerage system' is retained, then the imported manures, guano and bones, make their way into the sewers of the cities, which, like a bottomless pit, have for centuries swallowed up the guano elements of the English fields, and after a series of years the land will find itself precisely in the condition it was in before the importation of guano and bones commenced; and after England shall have robbed the cultivated lands of Europe, even to complete exhaustion, and taken from them the power to furnish her longer with corn and manure, then she will not be richer than before in the means of producing corn and meat, but will, from that time forth, become even poorer in these means.

" By means of the importation of guano and bones, the population has, however, in consequence of the increased production of corn and meat, increased in greater ratio than

would have been possible without this importation of manures, and this population will make upon the rulers of the State their natural demand for food.

" If men do not deem it desirable that the balance between population and the supply of food be restored by means of exterminating wars and revolutions (in which the want of food has always played a certain part), or by means of wasting plagues, pestilence, and famine, or by emigration *en masse*, then should they reflect that the time has arrived for getting a clear view in regard to the causes of existence and increase of population. A very little reflection will lead to the conviction that the relations of populations are governed by a great and comprehensive natural law, according to which the return, duration, increase, or diminution of a natural phenomenon depends upon the return, duration, increase, or diminution of its conditions. This law governs the return of the harvests upon our fields, the maintenance and increase of the population ; and it is easy to see that a violation of this natural law must exert upon all these relations a pernicious influence which can be set aside in no other way than by the removal of its causes. If, then, it is known that certain existing circumstances work deleteriously upon the fields ; if it can be foreseen that their continuance must bring about the ruin of agriculture ; if there is but a single one of all the means which have hitherto resisted this deleterious influence and made it less sensibly felt, which can be safely relied upon to secure a perpetual fertility to our fields, and this means, by a simple change and improvement of the existing deleterious state of things, can be obtained, then it becomes us to think whether a nation should not summon up all her intellectual and material resources in

order to preserve these fundamental conditions of her welfare.

"It has been maintained that the recovering of the manure-elements out of the sewers of large cities is impracticable. I am not ignorant of the difficulties which stand in its way. They are, indeed, very great; but if the engineers would come to an understanding with the men of science in relation to the two purposes—the removal of the contents of the sewers and the recovery of their valuable elements for agriculture—I do not doubt that a good result would follow. Intelligence in union with capital represents a power in England which has rendered possible and practicable things of much greater apparent difficulty. I look forward, with deep concern, to the solution of the sewerage question, for, if this question is decided in Great Britain without regard to the wants of agriculture, we can scarcely hope for any thing better upon the Continent.

"Permit me to add still a few words in relation to the leading article of *The Times* of the same date, in which the one side of this question is taken up with great clearness, while the author of the article seems to have not quite a correct view of its bearing as it presents itself to my mind. The mistake into which he has fallen arises from his confounding the condition of a State with that of its population.

"In the natural sciences we know nothing of a State—of its might or its feebleness. We know only lands, their geological formation, their climate and soil, and whether the soil contains the natural conditions of the subsistence of man and beast. In places where these conditions are

abundantly present, and geological circumstances do not hinder their intercourse, men cannot be exterminated. The most wasting war cannot rob a land of the conditions which nature has given, nor can peace give them to a land which wants them.

" Countries may be fruitful and become capable of sustaining a large population, when certain resisting influences, which, in their unhindered working, make the cultivation of the soil impossible, are overcome by human intelligence, or when a land has all the conditions of productiveness except one, and then receives the one which it lacked. If Holland were without her dikes, which must be kept up at great expense, she would produce neither corn nor meat; the land would not be inhabitable. In a similar manner, the inhabitant of the African oasis protects his grain fields by dikes against the storms of the desert, which cover his land with a barren sand; and if Mr. Layard is disposed to answer the question put to him, he will say that the decay of an admirable system of irrigation rendered the permanent maintenance of a great population in Assyria and Mesopotamia impossible.

" I know that the prophets of future evil have at all times been derided by their own generation; but, if history and natural laws can furnish any ground for a just conclusion, then there is none which stands more firmly than this—that, if the British people do not take pains to secure the natural conditions of the permanent fertility of their land—if they allow these conditions, as hitherto, to be squandered—their fields and meadows will at no distant time cease to yield their returns of corn and meat. But it does not belong to the province of natural science to

discuss the question whether the might, strength, and independence of the nation will be preserved after this state of things shall have gradually arisen.

"Believe me, dear sir, yours very truly,

"JUSTUS VON LIEBIG.

"Mr. J. J. MECHI, Triptree-hall, Kelvedon, Essex."

The economical merits of this question need not be further discussed, as they have been exhausted in the above paper. Let us endeavor, therefore, to throw out some suggestions of a practical nature.

The refuse matter of cities may be divided into—

1. *Street-cleanings, or what is incidental to traffic.*
2. *Garbage and ashes, or what is removed from the interior of houses.*
3. *Sewage, or the matter which is conveyed into sewers.*
4. *Night-soil, or excremental deposits which are not conveyed off by water.*
5. *Offal, or carcasses of dead animals.*

STREET CLEANINGS.

The constant sweeping of the streets is so essentially necessary to the preservation of health that it seems scarcely worth while to refer to it. Yet it is supposed by some that, unless the accumulation of mud or dirt becomes so great as to be offensive, that scavenging is a useless expense; and it is probable that, if it were put to vote, in some cities, whether the streets should be swept twice instead of three times a week, the latter increasing materi-

ally the expense, it would be decided in favor of sweeping but twice. It is not, however, generally known, that there is sometimes more danger to the health of a city from removing an accumulation of refuse matter than to leave it alone. For this reason frequent scavenging becomes a necessity. If the refuse has once been suffered to accumulate, it should not be removed in hot weather. An attempt to clean the streets of Vera Cruz, after they had been neglected for some time, almost involved the destruction of that portion of our army stationed there during the war with Mexico.

The material obtained from the streets has, in many instances, been used for filling sunken lots, and redeeming low ground. No greater folly could possibly be exhibited; for such a course has never failed to be followed by the most aggravated fevers; besides, the material properly belongs to agriculture, so that in an economical view it is wrong so to dispose of it. The proper course to pursue is to secure a piece of waste ground outside of the limits of the city, as a place of deposit for this material. This could be the more readily done in American cities, from the convenience afforded by the city railways, which are now being generally adopted. Transporting it in boats does not pay for the labor required. Whereas, with cars, the dirt can be dumped into them from a platform, and again dumped from the cars at the place of deposit. By a proper arrangement of pits, night-soil and even offal might be added to this deposit, and in time a most valuable accumulation of the richest kind of fertilizing material would yield a revenue to the city.

All of the streets should be swept at least three times a week, and the thoroughfares every night. The

manner in which it is done in Paris, as shown by the correspondent of the *Times*, exhibits the advantages derived from a thorough system. He states: "The general supervision of this branch of municipal administration is confided to the mayors, while its special supervision falls under the prefect of police. The sweeping of the streets is done at the charge of the proprietors, or where there are shops, no matter of what kind, at the expense of the owners of these shops; the average annual tax for this purpose is two dollars. The receipt for this money comes from the prefect of police.

Thus the citizens pay directly for the sweeping of the streets directly in front of their houses, but the city carries away the sweepings. This labor is now done by contract. The sweeping costs \$300,000 annually. The contractors who carry off the rubbish, after allowing it to rot a certain time in pits, sell it as manure, at the rate of three to five francs the cubic yard, and realize a total sum on its sale of \$700,000. The direct superintendence of the street sweeping is confided to officers responsible to the city government. The number of scavengers employed in this work in Paris is 2,500, including both sexes. They are divided into four legions, comprising twelve battalions, or thirty-six companies of four sections each.

The persons found employed in this work are almost exclusively Alsacians and Germans, but very many of them speak French as well. They are not at all miserable-looking people as one sees employed in similar labor in other cities, but, for the most part, young or middle-aged persons, in apparent robust health. The men are paid twenty-four sous (or cents) per day; the women

twenty sous, and the children sums in accordance with the labor they are capable of performing; for here street-sweeping, like other of the menial occupations, is elevated to the dignity of a science, and is learned by an apprenticeship. It must be confessed that this fact does not speak very loudly for the mental acquirements of the professors of this science, but there must be people for all occupations. The sweeps collect at given points, in companies of forty to sixty, every morning before four o'clock; they take their places in rank two by two, men and women, and the roll is called and the absent marked; at four o'clock they are all at their work. The work is performed by means of long switch brooms. They finish at or before eight o'clock, accomplishing the work in four hours. These hours are fixed, and invariably at eight o'clock the carts carry off the rubbish; no rubbish from the houses can be thrown into the streets after the hour fixed for the carrying off of the street sweepings.

At eight o'clock in the morning the fountains are opened, and the gutters are filled for an hour or more with streams of pure running water, a measure that is repeated in the course of the day, according to the wants of the season; and all this is accomplished every morning without confusion, and with the regularity of clock-work—a result due entirely to a careful organization and efficient superintendents.

The streets of Paris are thus always as clean as well-used brooms can make them. They are no relaxations—no experiments; it is a regular system, which works from January to January with the same daily efficiency, and is never the cause of complaint from any source. It is not regarded as an extraordinary feat

of administration, and any inefficiencies in its performance would be a matter of surprise. Besides this, a certain number of workmen, called cantonniers, are employed all day to work on the streets to scrape up the accumulating dirt, and to keep the gutters clear. A certain number of carts are retained all day to carry off the sweepings of these cantonniers. The sweeping of the public squares and gardens is done exclusively at the charge of the city.

GARBAGE AND ASHES.

It is a very common practice in cities—in fact in some of them it is established by ordinance—for the garbage and ashes to be exposed on the sidewalk in barrels and boxes, to be removed by carts which go around for that purpose. In this way, for a large portion of the day, a quantity of fermenting, deleterious substance is exposed in summer to the direct action of the sun, giving off the most venomous gases, while, frequently, from the overfilled barrels and boxes it is strewn over the sidewalk and into the street. A more reprehensible practice could not exist; the remedy for which is to have these barrels or boxes retained in the areas or yards under cover until the residents are notified by the ash-men to bring them out, and a law to this effect should be enacted and enforced in every city.

SEWAGE.

That the entire contents of the sewers of large cities may be successfully used to enrich the soil, there is no doubt, since it has been done in several European cities. The only question is to devise the most economical method

for accomplishing the object. Where the site of the town is elevated, it can be readily effected, as is shown in the case of the city of Edinburgh, the sewage of which is conducted over a considerable tract of meadows, on the east of the city, during the whole year, producing unexampled crops of grass, and commanding a high rent. The same facilities do not exist in towns which are located on or near the banks of rivers too low to admit of the sewage being conveyed to contiguous meadows. In Paris, however, the experiment has been successfully tried of pumping it up into reservoirs, and then using it for purposes of irrigation. In Birmingham, England, a similar use has been made of the drainage from the sewers. The evil effects which have been experienced in London, from the contamination of the waters of the Thames, have demonstrated the necessity of providing some other means for disposing the sewage of that city than by emptying it into the river, which has, in consequence, become a vast open sewer, giving forth the most noxious and offensive odors. The plan proposed to be adopted is to construct an immense main trunk sewer parallel to the river, which will receive the contents of all the sewers, and convey it to a distance below the city. There is no reason why this plan could not be adopted generally. It certainly is no reason for polluting the waters of a river because it is convenient to do so. As in the case of the Thames, there is a limit beyond which it is impossible to go without the most serious consequences resulting from it. So that it is better to provide, in the beginning, against the evils which must follow an increase of population.

NIGHT-SOIL.

Night-soil produces the most surprising effects when carried to the land, before its fermentation is completed,

and spread over it with care. The best way of using it is to form it into a kind of compost by mixing it with other substances, and especially by making it into heaps with turf, and adding a small quantity of burnt lime. By this means the superfluous energies are reduced to the requisite standard, and the effect extended over a greater space, without, however, there being any danger of the energy of the active matter which it contains being lost or impaired by this diffusion.

This manure then loses its fetid odor, and becomes divided and mixed up with the other substances, and forms a fertile soil. The best way of using it is to spread it over the ground, without covering it or burying it. It should be mixed up several times, and all the substances thoroughly mingled together before it is used.

In the neighborhood of Paris there is a large establishment in which a very active manure is manufactured from night-soil. It is made in the form of a powder, and for that reason is called poudrette. The excrementitious matter is placed on an inclined plane, covered with stone slabs, and there made into heaps in order that it may ferment, and when dry is spread over a greater extent of surface; a harrow is then passed over it to break it up, when it is frequently heated and thoroughly dried. It is then reduced to powder, which resembles brown tobacco in appearance, and sold to farmers, and particularly to gardeners, who, to judge from the price they pay for it, certainly must derive immense benefit from its use.

The inhabitants of Belgium also make great use of this kind of manure. They import and procure it from considerable distances, even in the form of a paste; and go to fetch it in carts and boats, without caring for the offensive odor

which it exhales. They either use it in the form of compost, or mix it with a large quantity of water. It is highly valued in China and Japan, and hence called Japan manure.

OFFAL.

Nothing is so essential to the sanitary condition of a city as stringent regulations and a well-devised system with regard to the removal and disposition of the carcasses of dead animals. Every moment they are exposed adds to their power of vitiating the atmosphere, and diminishes their value for economical purposes. In an establishment properly conducted by competent persons, with sufficient capital, the entire offal of the city might be turned to account. They should be removed as far as possible from the vicinity of dwelling-houses, and should be under constant supervision. Persons who are engaged in such occupations soon become accustomed to what would be to others the most offensive odors, so that they should not be the best judges as to whether they were conducting their business with the least possible annoyance to the neighborhood. The removal of offal should be under the direct supervision of the police.

Carts and men for this purpose should be stationed in the immediate vicinity of the station-houses, so that the moment a report is made on the subject from any of the precincts, the cart may proceed at once to the spot; and in transporting the offal, care should be taken that it be covered and hidden from the sight. Nothing can be more offensive than to see carcasses being carried through the streets. Deodorizers should be used to a greater extent during their transportation to the place of deposit.

By the exercise of skill, a large profit may be derived from converting the carcasses to economical uses. From the horns, hoofs, hair, hides, bones, &c., may be derived fat, glue, bone-dust, bone-black, bone-manure, leather, phosphate of lime, and much other material useful in manufactures. A large number of persons are employed in this occupation in Paris, and enormous profits derived from it. It is a question worthy the attention of capitalists as well as sanitarians.

Having thus endeavored to point out, in as concise a manner as possible, the necessity and the manner of disposing of the refuse matter of cities, it remains for those most interested to follow out the suggestions which have been made, or to devise more practical plans.

The experience of the most casual observer must confirm all that has been said as to the necessity of remedial measures of the most thorough description being adopted. And it becomes simply a question of duty, whether the intelligence of the age shall or shall not be enlisted in this sanitary crusade against human debasement. In vain has intellect been given to man, if he is content to exist, like the brute, in filth, or to inhale, at every breath, its venomous odors. Of what use is the free air of heaven, if he is content to live and sleep in ill-ventilated apartments? Of what use is the glorious sunlight, if he is content to shut it out from his dwelling? Of what use are his mental energies, if he cannot devise the means for the rational enjoyment of his existence?

While much is due from the individual to himself, no less is due from him as a member of society.

His obligations to society necessitate the observance of

its laws not the least, of which are those which comprehend the preservation of the public health.

Again society is organized for the protection of individual rights, such protection is due from society to its humblest member; and of all his rights, there is none more indisputably his, than that the air he breathes should be pure and uncontaminated.

The laws which protect the life or the property of the citizen, are of no more importance than those which protect his health, and the penalties which attend the violation of one, should as surely be meted out to the violator of the other.

To the end that the practical co-operation of the civil authorities may be secured for sanitary reform, the following draft of a memorial is submitted, with the recommendation that a copy, signed by the officers of the Convention, be transmitted to the authorities of every incorporated city in the United States.

FORM OF MEMORIAL.

To the Mayor and Council of the City of—

The undersigned, your memorialists, in the interests of their fellow-citizens of all classes, and acting on behalf of the National Sanitary Convention, assembled in the city of Boston, on the 14th day of June, 1860, most respectfully petition your honorable body for the appointment of a special committee to examine and report upon the following subjects, vitally connected with the welfare of your city, viz.:

The condition of the drainage of the city, as connected with the original topography of its site.

The character and condition of the pavements of the city.

The character and condition of the works for the supply of water. Or, if no works are constructed, the expediency of constructing works for supplying the city with water.

The character and condition of the sewers, or the expediency of adopting a system of sewerage.

The character and condition of the wharves.

The character and condition of the markets.

Also, to submit such recommendations as they may deem proper with regard to the cleaning of the streets the removal of garbage and ashes, and the proper disposition of night-soil and offal.

The undersigned regard the result of such investigations as being eminently calculated to advance the best interests of the whole community, by eliciting facts and spreading information with regard to sanitary reform, and your petitioners will ever pray, &c.

